

Exhibit A

Part 1

CMU v. Marvell

Technology Tutorial

CMU Technology Tutorial

Carnegie Mellon University and the Patents

Data Density on a Magnetic Hard Disk

Data on a Magnetic Hard Disk

Writing Data on a Magnetic Hard Disk

Reading Data on a Magnetic Hard Disk

Noise on a Magnetic Hard Disk

Viterbi Algorithm and the “Trellis”

Prior Art Viterbi Detector

The Kavcic-Moura Invention

Carnegie Mellon University

Carnegie Mellon

Pioneering Solutions for the World

- ▶ *Private research University*
- ▶ *Over 100 research centers addressing a broad range of interests and industries*
- ▶ *11,000 students*
- ▶ *75,000 active alumni*
- ▶ *4,000 faculty and staff*
- ▶ *World-class arts and technology programs*
- ▶ *Collaboration across disciplines*
- ▶ *Innovative leadership in education*
- ▶ *Faculty members are practicing professionals who bring extensive knowledge and experience*
- ▶ *Faculty and students work to solve real-world problems*
- ▶ *Top-ranked University*

Carnegie Mellon University

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Pioneering Solutions for the World



*The Data Storage Systems Center (DSSC) is an interdisciplinary research and educational organization whose mission is to **advance information storage technologies**. Faculty and students from a wide range of disciplines are developing the fundamental understanding of the science and **advanced engineering methods required for future generations of information storage systems**.*

Collaborative Effort Between Departments



Groundbreaking Patents

Carnegie Mellon

Pioneering Solutions for the World



Dr. Alek Kavcic

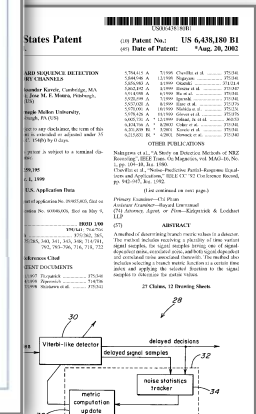


Dr. Jose Moura

U.S. Patent 6,201,839



U.S. Patent 6,438,180



insensitive detectors. It has also been demonstrated that the performance margin between the correlation sensitive and the correlation insensitive detectors grows with the recording density. In other words, the performance of the corre-

**A fundamentally new way
to accurately detect digital data.**

Source: '839 Patent
(Col. 2:1-2, Col. 13:40-43)

Data Density on a Magnetic Hard Disk

Components of a Magnetic Hard Disk Drive



Platter/Disk

*Stores **data** in millions of concentric **tracks***

One Track

*Contains millions of **magnetic bit regions***

Read/Write Head

- *Writes digital data as **magnetic bit regions***
- *Reads **magnetic bit regions** from the **tracks***

Read Channel Detector

Detects the data written to the disk

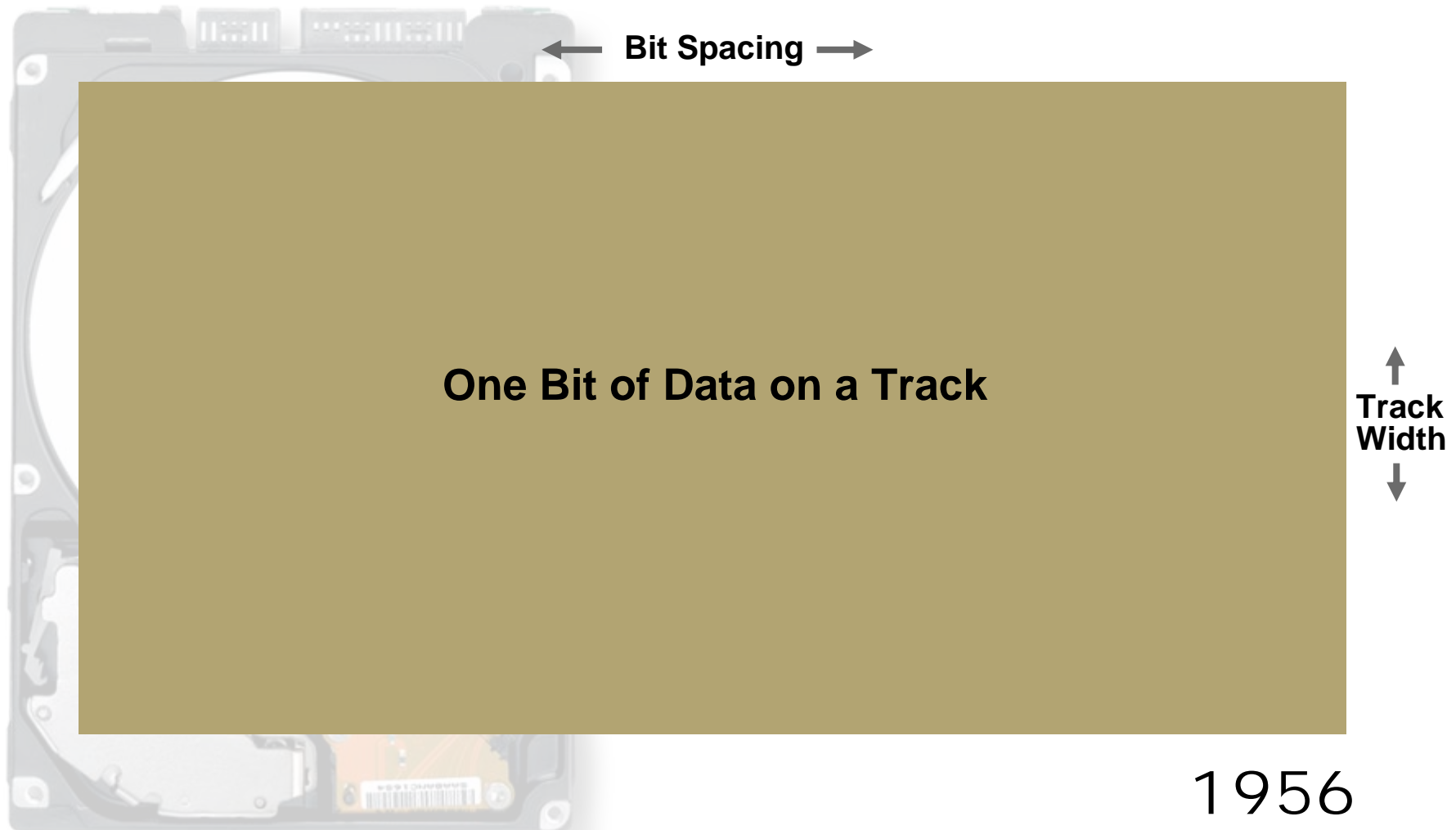
Components of a Magnetic Hard Disk Drive



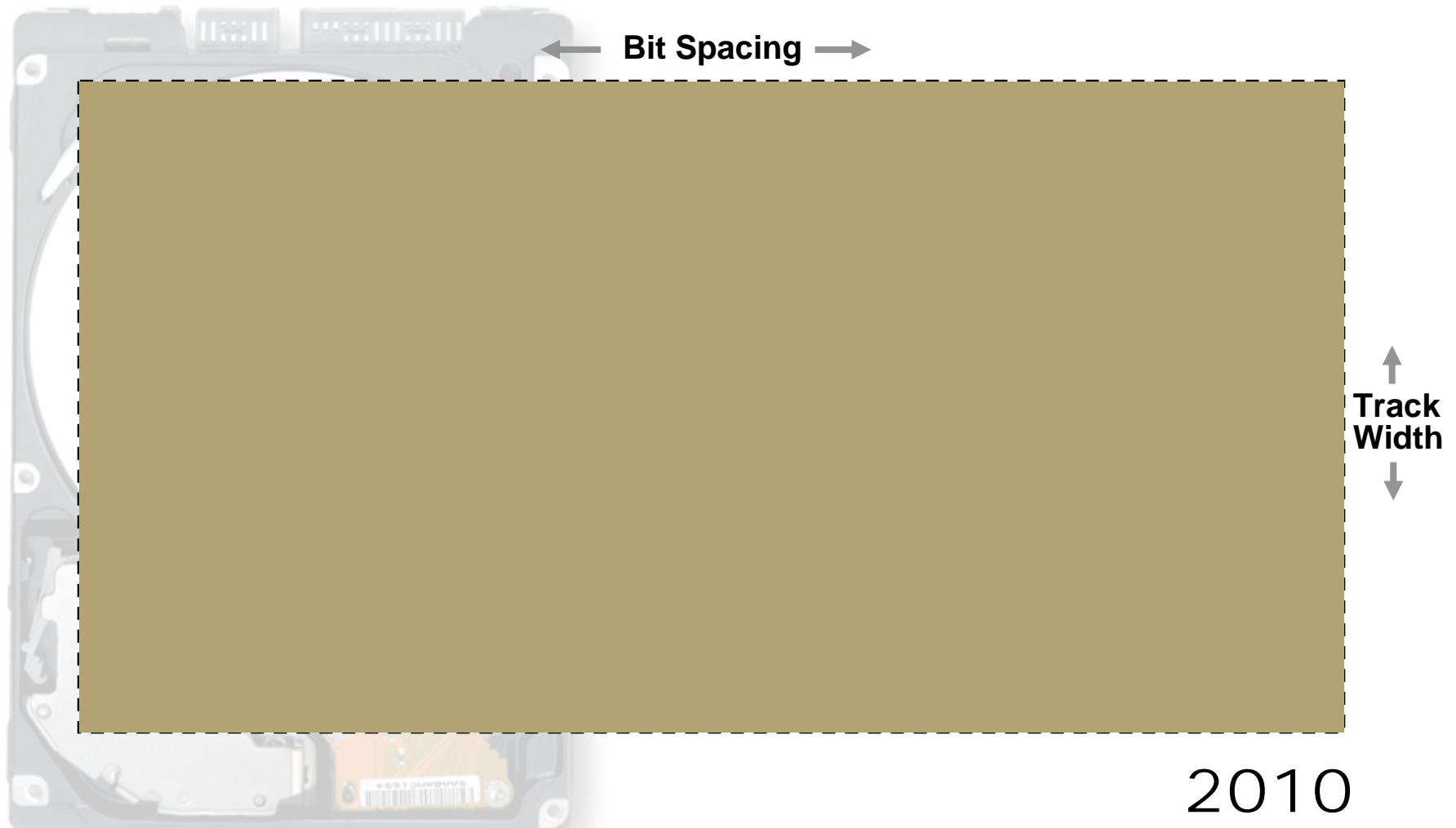
One Track

*Contains millions of **magnetic bit regions***

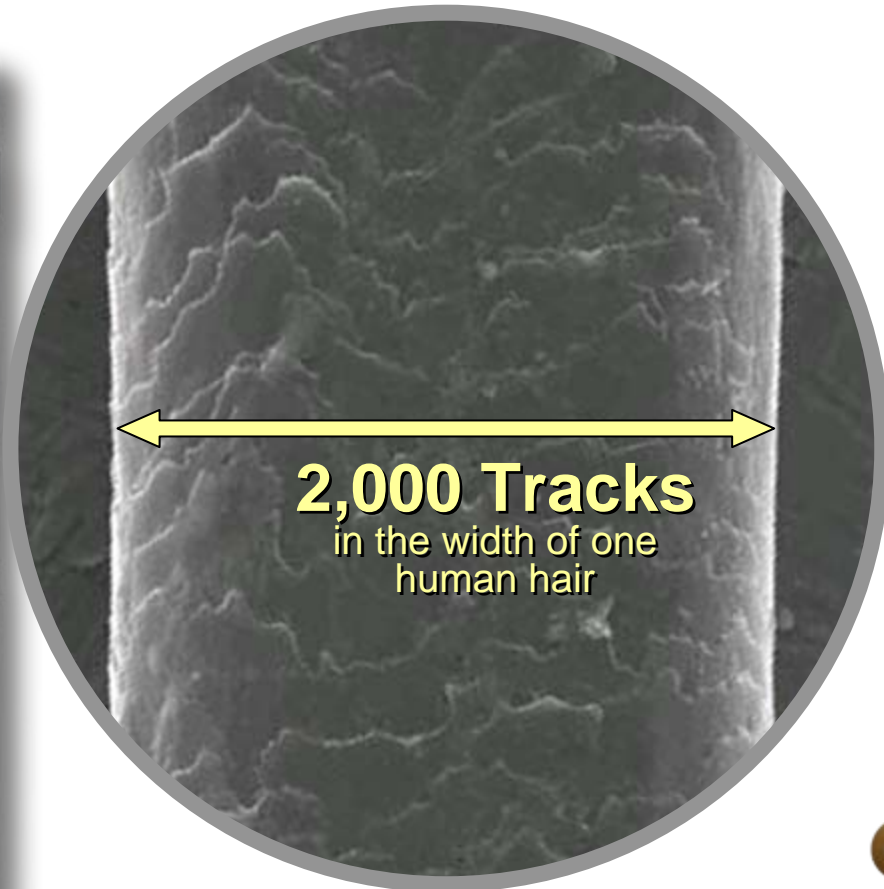
Data Density Has Increased Exponentially



Data Density Has Increased Exponentially



Data Density Has Increased Exponentially



Microscopic view of hair

Human
Hair



2010

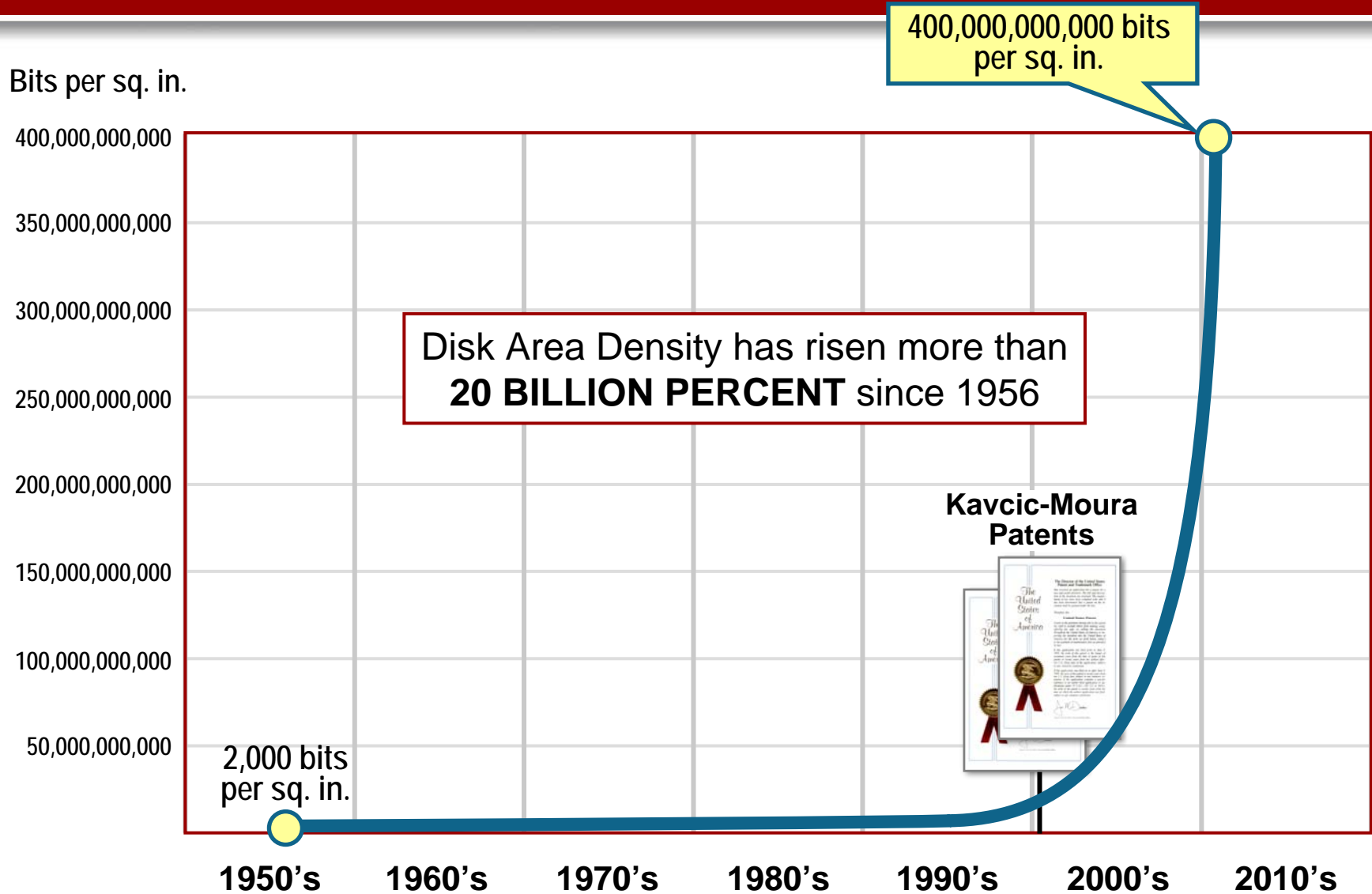
Data Density Has Increased Exponentially



**200,000 bits of data
in one inch of track**

Data density in 2001

Data Density Has Increased Exponentially



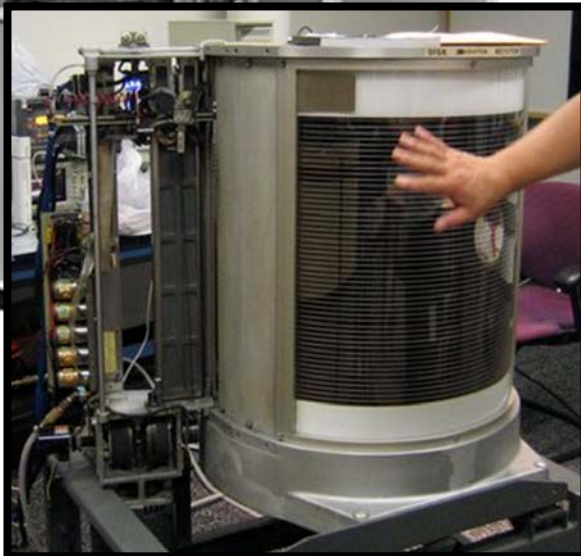
Miniaturization



1956

Hard Drive
52 disks
24 inches wide

5 MB
Capacity



2010



Hard Drive
4 disks
3.5 inches wide

1,097,152 MB
Capacity

Groundbreaking Patents

Carnegie Mellon

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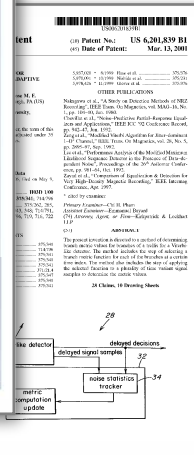


Dr. Alek Kavcic

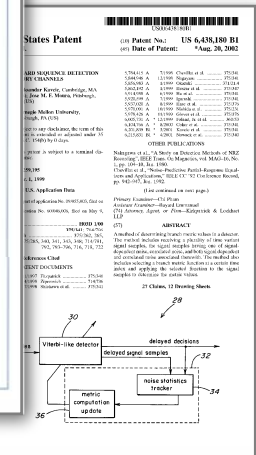


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U.S. Patent 6,201,839



U.S. Patent 6,438,180



**The Kavcic-Moura Invention
allowed for further miniaturization
when prior art could not.**

Common Devices Using the Kavcic-Moura Invention

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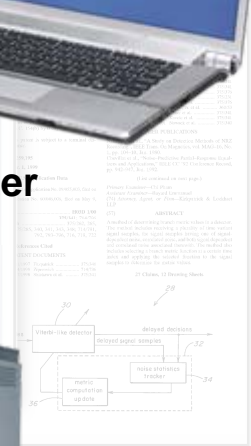
Desktop Computer



Laptop Computer

U.S. Patent

The United States of America



iPod Classic



Digital Video Recorder



Gaming Console



Dr. Alek Kavcic



Dr. Jose Moura

Data on a Magnetic Hard Disk

Magnetic Hard Disks Contain All Types of Data



Medical Records



Computer Files



Digital Images



Music / Movies

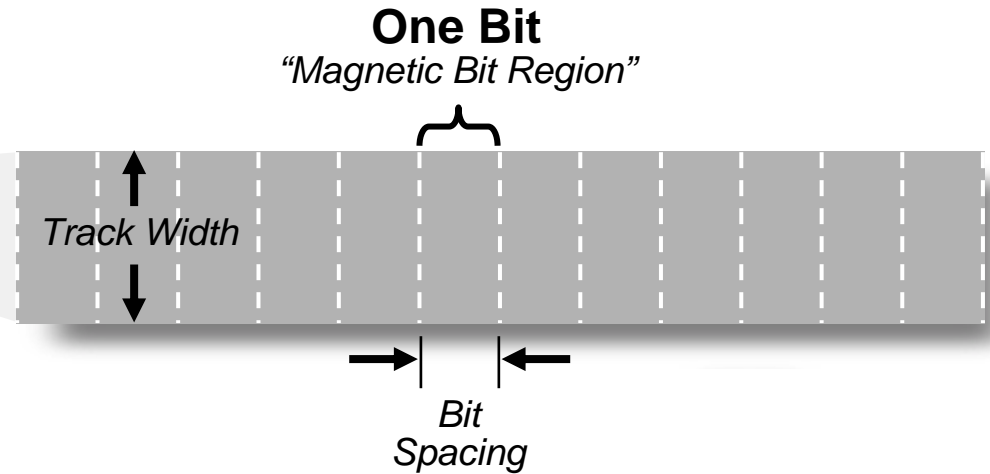
Data on a Magnetic Hard Disk



Track

*Stores data as **magnetic bit regions***

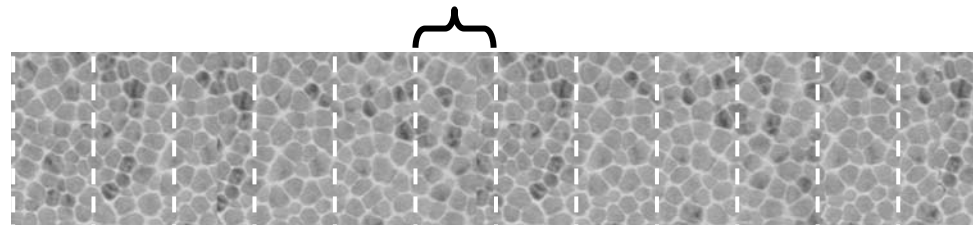
Data on a Magnetic Hard Disk



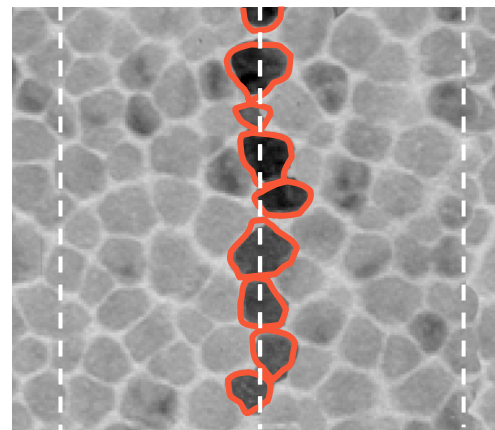
Data on a Magnetic Hard Disk



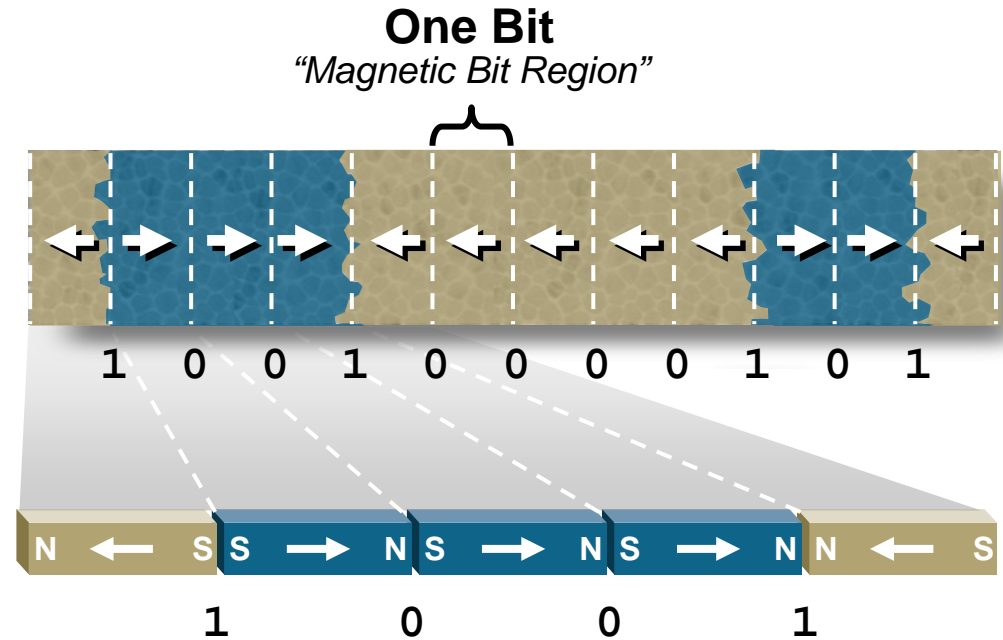
One Bit
Magnetic Bit Region



Granular Magnetic Medium



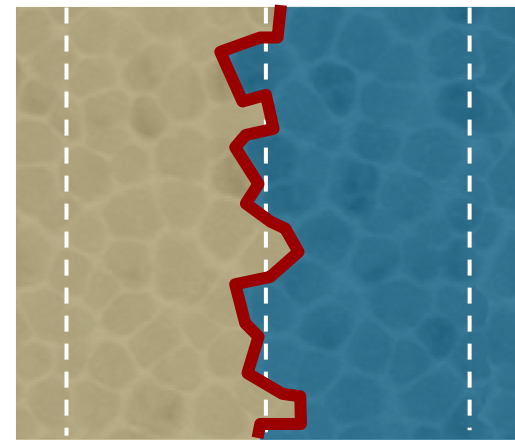
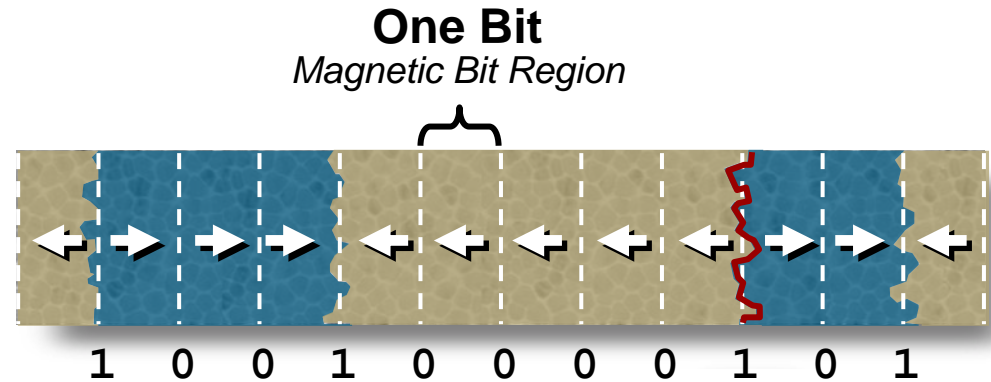
Data on a Magnetic Hard Disk



A binary "1" is stored as a transition between opposite polarities

A binary "0" is stored as a non-transition between opposite polarities

Data on a Magnetic Hard Disk



The jagged transitions caused by the granular medium create distortions in the signal (media noise)

Difficulties Due To Increased Data Density

Comparing data regions on a hard disk
to letters on a page

